

BLOOD TESTS IN CRIMINAL CASES NO LONGER UNCERTAIN

Murderers Can No Longer Be Shielded by Doubtful Analysis, for the Newest Biological Chemistry Can Now Tell Human Blood Stains from Others.

THIS sentence frequently occurs in the printed accounts of the arrests of persons suspected of crime: "Discolorations resembling blood stains were found on the clothing of the prisoner."

It has often happened in murder trials that the guilt or innocence of the prisoner depended entirely on the ability of expert witnesses to determine whether or not certain stains were caused by human blood. Formerly, this was a difficult question to decide. The revelations of biological chemistry, however, have made the tests comparatively easy. In fact, it is not too much to say that the tests used nowadays to settle the question whether certain stains, be they new or old, were made by human blood, constitute an exact science.

Cables from London the other day contained an announcement relative to expert testimony in a murder trial there, which has caused some rather quizzical raising of eyebrows among physicians and chemists in this city. This information was to the effect that Dr. Wilcox, Official Analyst to the Home Office, had testified at an inquiry into a murder charge that he had proved by the serum test that certain stains on the accused man's collar had been caused by human blood. The cabled dispatch added that this was the first time that the serum test had been employed in England, and that the test was the last word of science on the subject of discriminating between different kinds of blood stains.

In connection with this information an astonishing statement was sent along. This was to the effect that the test was infallible, with one exception—that of the higher apes. In other words, if this report is correct, while the British chemists can differentiate stains caused by human blood and the blood of all other animals except the higher apes by the employment of the serum test, the inference is drawn that man's kinship with the ape has been proved. Figuratively speaking, the serum reaction might be termed the much sought for "missing link."

It is often the case that scientific "discoveries" are cable from the Old Country only to be met by scientists here as old friends. So it is in this instance; the serum test for the differentiation of blood stains is part of the everyday equipment of the bio-chemist and medico-legal ex-

perient persons have trembled lest rust stains or stains caused by the blood of animals should be adjudged by experts (?) to have resulted from human blood.

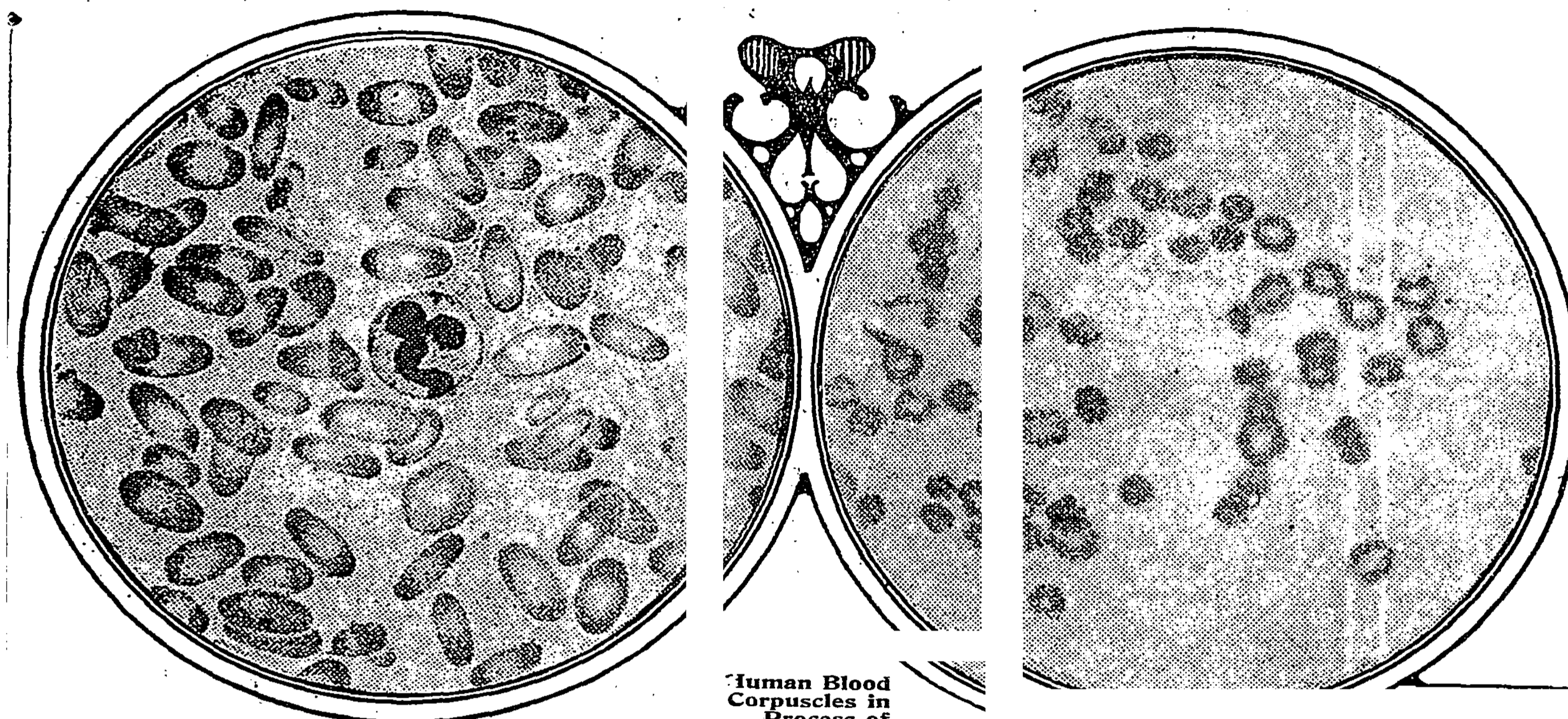
In cases of murder or assault what appear to be blood stains on the clothing of suspects must be examined with great care and with an open mind as to their possible causation. The evidence handed to the examiner should be kept by him under lock and key until its presence is required in court, so as to avoid the possibility of the addition of stains or the removal of those actually present.

Having reached the period when the examination is to be made, the following systematic scheme is recommended by Dr. Ewing in his article:

1. Gross examination.
2. Microscopical examination.
3. Guaiac test.
4. Haemin test.
5. Spectroscopic examination.
6. Serum test.

The gross examination of blood requires a knowledge of the manner in which it coagulates, and changes in appearance which are visible to the eye—such as changes in color. Of course, an intimate knowledge of the properties and composition of the fluid are necessary to an adequate understanding of these changes. It is necessary to remember that there are quite a number of substances which bear a resemblance to blood stains, and some of these may be excluded readily enough by a careful gross examination. It may require microscopical or chemical tests to eliminate the others.

"Iron rust varies greatly in its appearance," writes Dr. Ewing, "and some forms closely resemble dried blood, but it seldom presents a dark-red and glazed appearance. Knives used to cut acid fruits may present dark-reddish stains resembling blood, but containing dried



Human Blood Corpuscles in Process of Restoration.

Freak Red Blood Corpuscles in a Healthy Human Subject, Magnified 1,000 Times.

have been mistaken. Since the microscope furnishes extremely definite and reliable information regarding the minute characters of the material examined, it will always remain the most generally useful, as it is by far the most delicate instrument for the detection of the presence of blood, as it usually occurs in stains. Moreover, it may prove the only method applicable to extremely minute stains. In order to differentiate red blood cells



stains, since the size of these cells once furnished the only means of distinguishing human blood from that of other mam-

mals. Since the discovery of the biological or serum test for blood the exhaustive study of the size of red cells re-

stored from stains has been reduced to a secondary position. Yet this topic can never lose its importance, since it will always furnish valuable corroborative evidence of the origin of red cells, and it may still be found the only method applicable to extremely minute stains.

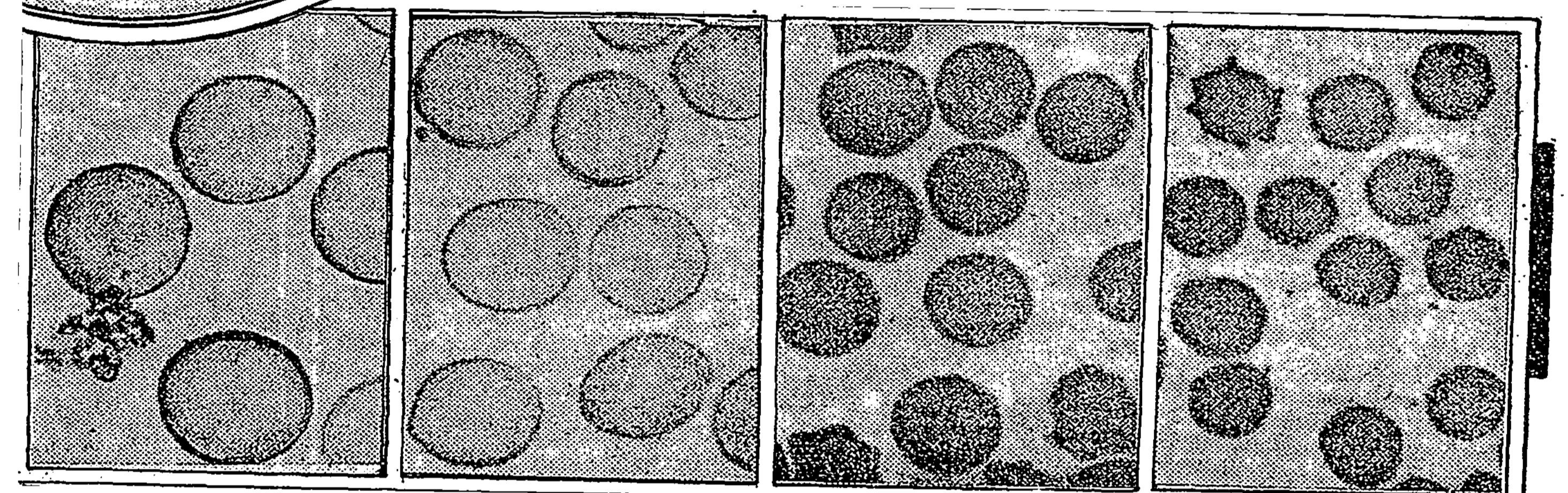
An idea of the delicacy of some of these tests, especially when the examiner has a specimen of dry blood to deal with, may be gained from the following description: "It is usually a very difficult undertaking satisfactorily to restore red cells from a dry clot, which fact accounts for the great variety of expedients suggested for the purpose. One should select from the spot a portion which gives evidence of most rapid drying, usually from the edge, and by means of a clean knife blade, transfer some of the powdered or scaly substance to a clean glass slide. To this should be added one or two drops of some fluid, which will isolate the coherent cells and tend to restore their original form, and the specimen covered with a cover-glass."

Here are the names of some of the

tin. These objects, which are known as "Teichmann's crystals," cannot readily be mistaken for "any other object in nature occurring under the same conditions." The test is described as follows in Witthaus and Becker's textbook:

"With dry blood of recent origin the simplest method suffices. A small portion of the clot or the material containing it is placed on a glass slide and moistened with a drop of 8 per cent. solution of common salt or a dilute solution of iodide of potassium. It is then evaporated to dryness by gentle heat, which is not sufficient to coagulate the albumens in the solution, covered with a small round cover glass, and a drop of glacial acetic acid is run under the cover glass. The specimen is then gently heated till bubbles of acid appear, at which temperature it is held until the acid is slowly and completely evaporated. By this procedure the blood pigment is dissolved by the acid and combined by the chlorine of the salt to form the hydrochloride or the anhydride of haematin, which crystallizes on evaporation."

The applicability of the spectroscopic to various differentiations is too well known to require explanation or extensive comment. The value of the spectroscopic examination of blood stains lies in the exact nature of the evidence furnished by the spectra of the blood pigments, and the applicability of the method to extremely minute quantities of blood and to all the decomposition products of haemoglobin. The spectra of blood pig-



Red Blood Corpuscles Magnified 2,500 Times. (1) Human; (2) Dog; (3) Ox; (4) Sheep.



Haemin Crystals.

pert. The test has been frequently employed in legal cases here and is made almost daily in scores of laboratories. Its description is a part of every up-to-date textbook on medical jurisprudence.

The laboratory workers on this side of the water have gone a bit further than their British cousins, however, if accurate reports of the recent proceedings in London previously mentioned have been received here. In this country the serum test has been perfected to such an extent that the trained physicians and chemists can distinguish between the blood of man and the higher apes.

The whole subject of the medico-legal examination of blood and other stains is dealt with in a comprehensive article written by Prof. James Ewing of Cornell University Medical College for Witthaus and Becker's "Medical Jurisprudence, Forensic Medicine, and Toxicology." Dr. Ewing devotes considerable space to the diagnosis between monkey and human blood, and describes these five methods which have been employed for the purpose:

The progressive dilution of the test serum.

The progressive dilution of the tested blood.

The absorption of the monkey receptors in the serum by monkey blood.

The use of a humanized serum prepared in the monkey.

The method of complement fixation.

The evolution of the blood test furnishes one of the most fascinating chapters in the annals of the criminal law. Thousands of guilty wretches have quaked with the thought that the stains on their clothing would be proved to have been caused by the blood of their victims. On the other hand, when the test was an imperfect one as many in-

vegetable cells colored with iron salts. A microscopical examination reveals absence of red blood cells and the presence of vegetable cells and detritus."

In addition vegetable dyestuffs, extracts of tanbark, and red paint may cause stains resembling blood, but the differentiation is readily made.

"By the use of the microscope," Dr. Ewing writes, "the examiner is enabled to identify any red blood cells that may be present, to determine the probable origin of these cells, the presence and probable origin of mucocytes, and the nature of any material with which the blood may have been mixed or for which it may

by the use of the microscope, the comparative morphology of cells must be understood. Next, it must be known that among the most reliable indications of the identity of red cells are their staining properties. Then the examiner must know how to stain them properly for inspection under the microscope. Regarding the question of the size of red cells, Prof. Ewing writes:

"The determination of the size of the red cells has long been one of the most essential as well as difficult problems in the medico-legal examinations of blood

liquids used to isolate the coherent cells: Virchow's fluid, Puppe's fluid, Roussin's fluid, Ranvier's fluid, Vibert's fluid, Paccioni's fluid, Muller's fluid, and Pottain's fluid. Some of these fluids are strongly alkaline, others are neutral, and the rest are acid. The object of employing these fluids, as the writer explains, is to secure the isolation of coherent red cells without their destruction, and then they can be examined with the aid of the microscope. It is a matter of great delicacy to measure the restored cells. It is done by means of a screw micrometer eyepiece and a stage micrometer.

As there are conclusions from the gross examination of blood stains, so also conclusions result from the microscopical examination. The latter will warrant a positive opinion, for one thing, that a stain does or does not contain blood.

The guaiacum test is used chiefly as a preliminary step in the examination of a series of articles submitted as possible blood stains. If the test is negative, it is usually safe to conclude that the stain is not blood, although very old blood may not react in a satisfactory manner. The principle is this: Blood treated with guaiac and old oil of turpentine containing unstable oxygen gives a blue color.

The haemin test is so called because it is the principal chemical test for blood pigment. It depends on the formation of certain characteristic crystals of haema-

ments vary distinctly with the chemical changes which the pigment may undergo.

Now we come to the precipitin serum test, that which is deemed to be infallible. The original observations resulting in the precipitin test were made fourteen years ago by Kraus. He obtained albuminous precipitates in certain cultures of bacteria by adding homologous immune sera. Later others demonstrated that most animals develop precipitin sera against alien blood. Rabbits have been chiefly used in these experiments, and, writes Dr. Ewing, "specific anti-sera have been developed in this animal (the rabbit) for the blood of man, monkey, beef, goat, sheep, horse, dog, guinea pig, hog, and many ovipara and cold-blooded animals, as the chicken, alligator, turtle, frog, lobster, eel, and crab. The writer found that the chicken develops an active and highly specific serum for man and rabbit."

Here is the method of producing and using the precipitin serum: Healthy field-rabbits or hares are selected and confined in sanitary surroundings. Fresh human blood is taken and the fibrin removed by shaking it in a sterile flask containing beads. From 5 to 10 cubic centimetres of the defibrinated blood are injected into the rabbit. From six to ten injections are given at about four-day intervals, when a good serum may be expected to develop.

A week after the final injection blood is withdrawn. The serum exudes from clots forming in the test tubes laid nearly horizontal. Next, the dried blood to be tested is prepared. A chemically pure common salt solution of 6 to 8 per cent. is used to dissolve the dried blood. This solution may be filtered to clear it. Then it is put in carefully cleaned and sterilized test tubes of small calibre. Each tube should contain ten drops of the blood solution, to which is added one drop of pure serum added to four drops of salt solution.

If the dried blood is human blood the addition of the humanized serum will result in the characteristic reaction—a heavy or flocculent precipitate. If the specimen is not human blood the addition of the humanized serum will simply result in the production of a homogeneous, clear liquid; there will be no change. It may require three hours to obtain the characteristic reaction.

Prof. Ewing states in his authoritative article on the serum test that it is possible by careful calibration of the test serum to distinguish higher monkey blood from human by the precipitin test.